


Out of Harm's Way

International collaboration helps keep nuclear materials out of the hands of terrorists.



THE September 11, 2001, attacks on the U.S. and subsequent bombings in Madrid, Bali, London, and Moscow vividly demonstrate the determination of terrorist groups to strike fear and inflict mass destruction. Keeping nuclear materials and weapons safe and secure is imperative.

Nowhere has the challenge of protecting these materials been greater than in the former Soviet Union. The security system for protecting vast stockpiles of nuclear warheads and materials fell into disarray when the Soviet Union split into individual states in 1991. With the Russian government in transition, financial support for nuclear sites was chaotic at best. A social and economic malaise set in. Scientists and other nuclear workers were not paid for months, and the infrastructure at nuclear facilities began to crumble.

This situation was ripe for clandestine operations by rogue nations or terrorists who wanted to acquire these extremely dangerous materials. Reports of stolen nuclear material began to surface. Poverty-stricken nuclear scientists with their weapons know-how became targets for bribery.

Sixteen years later, the Russians have markedly improved their security, thanks in part to several programs implemented by the Department of Energy (DOE) in the early 1990s. One such program is called International Material Protection and Cooperation (IMPC). Now managed by DOE's National Nuclear Security Administration (NNSA), the IMPC Program focuses on upgrading protection, control, and accountability systems to safeguard nuclear materials.

Through IMPC, Russian facilities are now equipped with alarmed fences, electronic access control and delay systems, vehicle inspection facilities, and alarm control and display consoles. Accounting and control systems also measure, track, and monitor nuclear material inventories, and new regulations and procedures help protect Russia's civilian and military nuclear sites.

Perhaps most importantly, scientists and nuclear workers in Russia recognize that protecting these materials is fundamental to global security. To further promote a culture of nuclear safety and security, NNSA sponsored a graduate program on the protection, control, and accounting

of nuclear materials at the Moscow State Engineering Physics Institute. Program graduates are ardent proponents of the multilayered approach to security that is common at U.S. facilities.

Cooperation Is Key

NNSA's IMPC Program, formerly called the Material Protection, Control, and Accountability Program, is a cooperative effort with the Russian Federation. The program focuses on protecting facilities that process or store weapons-usable nuclear materials. Security has been enhanced at various locations, including weapon design institutes, naval bases, uranium and plutonium storage sites, fuel processing centers, and nuclear power reactors. Livermore has been a leader in the program from the beginning. (See *S&TR*, September 1997, pp. 14–23; September 2000, pp. 4–12.) Since the early 1990s, dozens of security projects have been implemented across Russia.

The NNSA program receives high-level governmental support in both countries. Russian Prime Minister Viktor Chernomyrdin worked with U.S. Vice President Al Gore to place presidential emphasis on the initial program. Later, DOE Secretary Bill Richardson signed some of the first protocols with the Russian

military. At a 2005 summit in Bratislava, Slovakia, U.S. President George W. Bush and Russian President Vladimir Putin agreed to enhance and accelerate their countries' cooperation in defending against nuclear terrorism.

The 9/11 attacks gave the program a sobering boost. "We had been humming along, improving protections at an array of sites, when 9/11 happened," says Mike O'Brien, the deputy program leader for Livermore's IMPC effort. "Almost overnight, we had a much larger project. We had to evaluate more sites and develop more improvements—all within a much shorter turnaround time."

The initial work focused on securing points of origin, such as storage sites and nuclear research facilities, and on creating a first line of defense around them. IMPC is also addressing the second line of defense, developing methods to better monitor Russia's border crossings and shipping ports.

Protecting the Goods

Personnel at a U.S. nuclear weapons laboratory such as Livermore deal with this issue daily and understand the multiple layers of security. "Guns, guards, and gates are obvious tools for protecting nuclear materials," says Mo Bissani, who leads

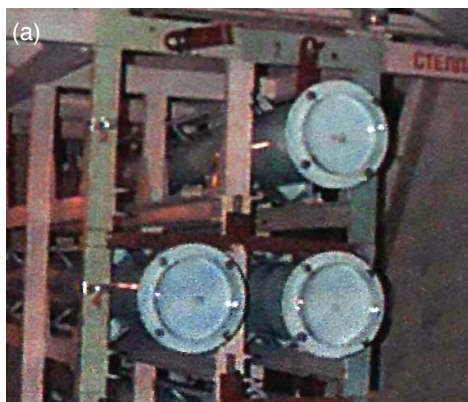
Livermore's IMPC Program. Even more important, however, are the less noticeable regulations and procedures, such as material accounting and monitoring procedures, vulnerability analyses, protection plans, training programs, and an ever-present awareness by employees of safety and security. For example, a basic rule throughout DOE's NNSA complex is that two people must be present when working with nuclear materials. This two-person rule not only improves safety but also helps prevent insider threats, where site personnel attempt to steal materials.

According to Bissani, the first step in protecting materials against both external and insider threats is to characterize a site's inventory. Laboratory staff work with Russian personnel to evaluate how much nuclear material a facility has, how "attractive" the material is for terrorist activities, where the material is stored, and what those storage conditions are. The collaborative teams then examine improvement options, often using computer models to compare choices, and validate the results before implementing protective upgrades.

The Livermore IMPC team also helps train Russian technical personnel to perform vulnerability analyses using the Analytic System and Software for Evaluating Safeguards and Security (ASSESS) methodology, which was developed at the Laboratory. IMPC team member Bill Abramson has been teaching the vulnerability analysis concept since 1996. Since then, hundreds of technical staff members at Russian facilities have been trained.

The first site to implement ASSESS was the Kurchatov Institute, Russia's premier nuclear physics research laboratory. A DOE team worked with the Moscow institute to install an array of physical protection and monitoring systems. Today, Livermore personnel provide support to maintain these upgrades.

ASSESS is also being deployed at Chelyabinsk-70—a site of special interest



(a) Before the Department of Energy initiated the International Material Protection and Cooperation Program, the Russian Federation stored highly enriched uranium in canisters with tamper-indicating devices but no alarms. (b) Today, canisters are behind alarmed doors that must be opened remotely.



for the Laboratory. Chelyabinsk-70 is the second nuclear weapons design facility established in the Soviet Union and home of the All-Russian Scientific Research Institute of Technical Physics. Now called Snezhinsk, the town is the sister city for Livermore, California.

Seals and tamper-indicating devices are essential parts of material protection and control. At U.S. nuclear sites, these are electronic devices that trigger alarms and other alerts when material security has been compromised. Before IMPC, such devices at Russian facilities often consisted of string and sealing wax. A broken seal indicated that someone had tampered with the goods. But these inexpensive seals cannot identify who accessed material or when, and they do not prevent theft. Resealing a container is also relatively easy. To improve security at the Russian facilities, personnel from Livermore and other national laboratories led workshops demonstrating

the importance and use of more secure tamper-indicating technologies.

The Laboratory's IMPC team has been involved in vulnerability analyses and protective upgrades at nuclear bases operated by the Russian Navy. The Navy's northern fleet is headquartered near Murmansk and has bases along the northern coastline of the Barents Sea above the Arctic Circle. The Pacific fleet, headquartered in Vladivostok, has bases along the Pacific coastline and around the Kamchatka Peninsula. IMPC teams have worked with the 12th Main Directorate and the Strategic Rocket Forces of the Russian Ministry of Defense to address security concerns at these remote bases.

O'Brien, who has worked with IMPC since the program began, recalls that success with the icebreaker fleet at Murmansk was key to winning over officials of the Ministry of Defense and the Russian Navy. The Murmansk effort demonstrated NNSA's dedication to

the IMPC Program. The administration assigned a team of researchers from Lawrence Livermore, Los Alamos, Oak Ridge, and Sandia national laboratories to work solely with the Russian Navy. At the time, these four institutions were the only U.S. laboratories authorized to work with the Russian Ministry of Defense.

Abramson continues to travel to four naval bases on the far eastern coast of Russia where he leads a project to improve nuclear security. He worked with the Russian teams to conduct vulnerability analyses at each site. Since then, the bases have installed barriers, closed-circuit television monitoring systems, alarms, access controls, and portal monitors.

"In an area that averages 10 meters of snow annually, an important upgrade was better facilities for guards," says Abramson. Not only are the facilities improved from a security standpoint, but they now also have more protected muster areas, break rooms, and places for workers to escape the cold



Security has been upgraded at civilian and military nuclear sites throughout the Russian Federation.

while on duty. Vehicle inspection portals can now be enclosed in winter so inspectors are protected from the cold and flying snow. Because the weather is harsh and the bases are remote, upgrades included emergency generators to ensure that lighting, alarms, and computer-controlled systems operate continuously.

Another way to keep weapons-grade nuclear materials out of harm's way is to mix them with other substances, a process called down-blending. The result is a material that is less attractive to terrorists because it is more difficult to use in an improvised nuclear explosive device. Down-blended materials are analytically verified and stored in a secure location. Material that cannot be down-blended is consolidated, when possible, for storage. The Laboratory's IMPC team helped standardize packaging containers and develop machine-readable identification codes for container labels.

Maintaining Control

In the past, the Soviets accounted for special nuclear materials in financial terms rather than by quantity and did not maintain a national-level automated accounting system. In 1996, Livermore's IMPC team began leading a project to help Russia implement a more effective approach. The Federal Information System (FIS) is designed to track and monitor nuclear materials in Russia's civil sector. The system is based on the Nuclear Materials Management and Safeguards System used by DOE, NNSA, and the U.S. Nuclear Regulatory Commission and meets the reporting requirements of the International Atomic Energy Agency and other international standards and treaties.

In 1998, following a series of training workshops, Russian scientists produced a report that summarized how the DOE/NNSA system could be applied in Russia. Livermore and Russian scientists then

jointly developed software specifications, levels of reporting, types of reports, and documentation for the Russian system. "FIS standardizes the codes that the civil sector uses in Russia," says Rusty Babcock, who joined the FIS project in 1997 and has led it since 2000. "FIS also standardizes the rules and frequency of reporting for a national material control and accounting program."

Russia began deploying this comprehensive system at its civilian nuclear sites in 2001. The 60-plus sites under the authority of the Federal Agency for Atomic Energy reported data to the system for the first time in January 2002. Each facility has several areas where nuclear materials are located. Data are summarized at the site level and eventually reported to the central Russian government.

Currently, FIS reports are compiled annually, but more frequent and detailed reporting cycles are planned. The U.S.



At one Russian site, a new facility was built so that guards are stationed closer to the materials they protect, which shortens response time in an emergency.



Weapons-grade nuclear material is "down-blended" by mixing it with other substances before it is placed in permanent storage. This down-blended material is less attractive for terrorist activities.

has supported the hardware and software developments needed to improve Russia's electronic infrastructure so that remote sites can submit reports to FIS.

Keeping It Running

Livermore's IMPC team also helps Russia ensure that upgraded sites are kept in top condition. "After 15 years, we are wrapping up the security upgrade phase of the project," says Bissani. "We are working with our counterparts to develop systems for maintaining the protective infrastructure." Comprehensive regulations, continued training, systematic inspections, and routine maintenance are considered key to sustaining the effectiveness of protections in place.

O'Brien leads an effort with the Kurchatov Institute to develop regulations related to nuclear security for the Russian Federation's Ministry of Defense. The team has identified the regulatory needs

for the military services and anticipates completing the work in 2012.

Training for the Russian military is an important element of IMPC's sustainability phase. A recent achievement is the Kola Technical and Training Center established for the Navy's northern fleet. Oak Ridge worked with the Livermore team to design the center at Severomorsk, about 640 kilometers northeast of Moscow. In July 2005, the center was officially dedicated by Russian leaders and NNSA administrator Linton Brooks.

More than 600 naval personnel, including security managers and system operators, receive training each year at the Kola center. Laboratory scientist Mary Huddleston led the team assigned to develop the center's training courses. Approximately 40 courses address such issues as console operation; badging procedures; access control; security system design and maintenance; and management

procedures for material protection, control, and accounting.

Abramson is helping the Russian Navy establish a similar facility for its Pacific fleet. Livermore's Melinda Lane will adapt the Kola training program for use at the Pacific facility.

The Bigger Picture

In 2006, NNSA began a collaboration with Ukraine and Kazakhstan to strengthen the nuclear security regulatory systems and standards in those countries. At a joint workshop in June 2006, researchers from Lawrence Livermore and Pacific Northwest national laboratories met with their counterparts in Ukraine and Kazakhstan to review assessments and prioritize the proposed schedule for modifying regulatory documents and developing new ones.

The IMPC Program is also exploring areas of cooperation with China. A joint

Russia's nuclear material accounting system is called the Federal Information System (FIS). The National Nuclear Security Administration initiated an annual magazine, *News FIS*, to keep nuclear staff informed about training, procedures, forms, and other system updates. The magazine's Web site (www.fisnews.ru) also helps employees stay up to date.

program between IMPC and NNSA's Office of Nonproliferation and International Security enlisted personnel from Lawrence Livermore, Sandia, Los Alamos, and Oak Ridge to collaborate with their technical counterparts in China.

In 2005, as part of a coordinated material protection, control, and accounting demonstration, Livermore and Sandia worked together to upgrade systems at the Fast Neutron Critical Facility and a materials storage facility for the China Institute of Atomic Energy. A safeguards laboratory at the institute hosted technical exhibits in conjunction with the demonstration. At the exhibit, O'Brien presented DOE/NNSA-approved procedures for vulnerability assessments, physical protection, regulations, and inspections to Chinese safeguards engineers and analysts and civilian nuclear industry officials. Livermore's Wayne Ruhter discussed nondestructive analysis techniques, and Babcock explained national-level nuclear material accounting procedures. In the current phase of the program, O'Brien is training Chinese nuclear personnel to analyze insider threats.

Largely because of 9/11 and its aftermath, NNSA is overseeing a second program, called the Global Threat Reduction Initiative, to reduce and secure radiological materials at research reactors and other locations throughout the world. This initiative is being carried out in



Continued training is an important component of sustaining the security upgrades and new mind-set about security. The Kola Technical and Training Center, which opened in 2005, serves personnel of the Russian navy's northern fleet.

cooperation with the International Atomic Energy Agency and other global partners.

In response to evolving threats, Livermore and other national laboratories have helped lay the groundwork for safer, better protected nuclear sites in Russia and other countries. Laboratory scientists have gotten to know their Russian counterparts very well, a concept unimaginable not so many years ago. Together, they are imbuing a culture of safety and a sense of collective responsibility within the Russian nuclear community because, in the end, personnel reliability and trust are the



Livermore scientist Mike O'Brien presented a technical briefing on nuclear security to staff at the China Institute of Atomic Energy.

keys to nuclear material protection. And safeguarding those materials is central to global security.

—Katie Walter

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